

# Capillary Electrophoresis

**Capillary electrophoresis (CE)** is used to separate organic and inorganic anions and cations. It provides both qualitative and quantitative information. Its modes of operation include micellar chromatography and isotachopheresis.

## Principle of Technique

Nanoliters of sample are injected into capillaries (both uncoated and coated) ranging from 50–100  $\mu\text{m}$  in diameter and 25–75 cm in length. The capillary is continuously filled with an electrolyte solution and subjected to voltage gradients of approximately 600 V/cm. Ions are separated because of their different mobilities in the presence of the strong electric field. After separation, the ions are detected by ultraviolet absorbance using a diode array detector. CE provides separation of analytes with high resolution ( $10^5$  to  $10^6$  theoretical plates) in less than 10 min.

## Samples

**Form.** Sample must be in an aqueous solution and be soluble in the electrolyte system chosen.

**Size.** Only a few nanoliters of sample are injected onto the capillary column but sample volumes of 100  $\mu\text{L}$  are preferable. Analyte concentrations in the low parts per million are required. Detection limits are dependent on the UV absorbance of the analyte (direct detection) and the electrolyte system (indirect detection).

**Preparation.** All samples must be filtered prior to CE separation. Complex samples may require some cleanup.

## Limitations

Analytes must be soluble in the electrolyte of choice.

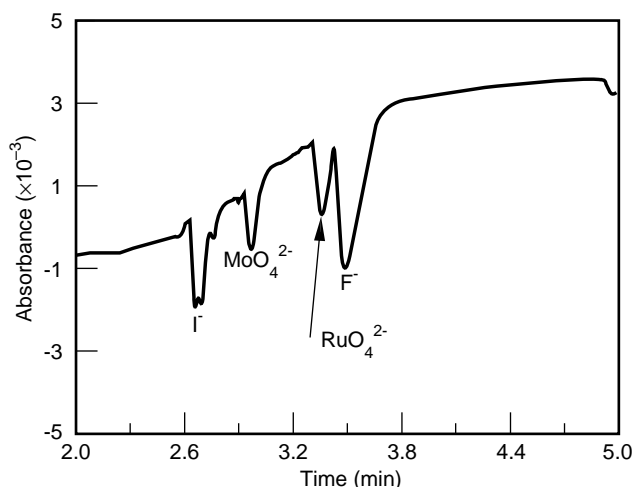
Analytes without significant absorbances in the UV must be analyzed in the presence of an absorbing background electrolyte (indirect detection). Complex matrices hinder CE analysis—changes in solution ionic strength and pH may change ion migration times.

## Estimated Analysis Time

Typical CE analysis times are under 10 min. However, sample and standards preparation and data analysis and interpretation bring the average analysis time to an hour or more.

## Capabilities of Related Techniques

Ion chromatography is the technique that is most comparable to CE for the analysis of anions. Organic analyses can also be performed by gas chromatography, liquid chromatography, gas chromatography-mass spectrometry, liquid chromatography-mass spectrometry, Fourier transform infrared, and other methods.



CE is used in nonproliferation research to separate iodide, molybdate, ruthenate, and fluoride. Detection is by indirect UV adsorption.

## Examples of Applications

- Separation of inorganic anions.
- Analysis of explosives.
- Analysis of oxalate, tartrate, malate, succinate, lactate acetate, propionate, butyrate, and caprylate anions.
- Analysis of organic acids in wine.
- Analysis of metal cations.
- Analysis of amino acids and nucleotides.

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